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ABSTRACT

The Design Assessment Scale for Elementary Schools (DASE) assists educators and architects in planning and designing developmentally appropriate learning environments for elementary schools. This article examines DASE, its introduction and development, the first step in the instrument's validation process, and the initial reliability coefficients. Also described are each of the DASE facility design assessment components for measuring the degree of functionality, safety, adequacy, quality, pattern, and overall impression. The article concludes by describing a design assessment scale for elementary schools in terms of validity and reliability. Contains 23 references. (GR)

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A Design Assessment Scale for Elementary Schools

C. Kenneth Tanner

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Abstract:
A Design Assessment Scale for Elementary Schools (DASE) is under construction at the University of Georgia's School Design and Planning Laboratory. Its purpose is to assist educators and architects in planning and designing developmentally appropriate learning environments for elementary schools (pk -5). We are also currently working on scales for middle schools (grades 6-8) and high schools. The DASE is intended to measure various aspects of design practices presently existing in schoolhouses and outdoor learning areas. This report includes the first step in the instrument's validation process and the initial reliability coefficients. Two questions are under study: Does the DASE include the most significant and valid aspects of design for elementary schools? Will it consistently measure these important design patterns?

> " ... if scientific proof could be found regarding the design patterns' influence on these areas, then recommendations on physical design of schools could be made with certainty."

Mary Burke Elementary, MA, HMFH Architects

Introduction:
In May of 1997, the School Design and Planning Laboratory was created to work on the problem of making physical learning environments more "learner-friendly." Specific attention was to be focused on the use of technology in conducting research, providing service, and delivering instruction in this rapidly growing academic area. The clients of the SDPL were defined as educators and citizens involved in designing, planning, and constructing schools that serve the pre-kindergarten through the grade 12 population.

One of the on-going studies in the Laboratory deals with the difficult tasks of defining and measuring the degree of functionality and adequacy of school design characteristics or patterns. We assumed that once these were identified and properly validated, an association, and perhaps causality, might be established between school design patterns and student learning. We further assumed that these weighted design patterns might be compared to such measurable characteristics as student behavior, self-concept, and attitudes - all of which have been determined to affect student learning. We reasoned that if scientific proof could be found regarding the design patterns' influence on these areas, then recommendations on physical design of schools could be made with certainty - [The goal? "Learner-friendly schools"].

Behavior of students may be measured in terms of social conduct in the schools.

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Student behavior, given the violence on schools grounds, is tied to issues of safety and security as well as discipline. Frequently, attention is given to disruptive or abnormal behavior. Fighting among students, possession of illegal objects and drugs, and clashes with authority figures are examples. These negative aspects of student behavior are being measured by frequency counts. But, major aspects of positive student behavior such as participation in school and community activities also need to be included in assessments of student behavior. Future projects will include the development instruments that give attention to positive behavior as well as the more common emphasis on negative behavior. It is logical to assume that educators need to pay more attention to rewarding "good" student behavior.

Behavior and achievement (academic and nonacademic) influence a student's self-concept. Research literature is replete with findings on these relationships, much of which has been influenced by the popular psychologist, Carl R. Rogers. Attitudes influence learning; furthermore self-concept and attitude have been found to be related.

But, can we say, with certainty, that if the school's physical environment influences attitude, it must also affect self-concept and behavior? Attitude, behavior, and self-concept are related. Works by prominent researchers such as Skinner (environment as a behavior modifier) and Lewin (behavior is a function of the field that exists at the time the behavior occurs) document evidence of these relationships. I offer the proposition that these are all influenced by school design patterns but can not prove it scientifically. Design assessment scales for schools may evolve to be the instruments that will help us say, with certainty, that school design influences student learning. It may even give us an index to actually say "how much". At least, when we combine the a scale such as DASE, with proven measures of behavior, attitude, self concept, and social and economic indicators, a stronger and more accurate index for predicting student achievement and other defined outcomes is highly likely.

The Instrument's Development:
Before validity can be demonstrated, the DASE must first yield consistent and reliable measurements. The questions addressed in this study are 1- What are some important, measurable, designs to include in the DASE. 2- Will these measurable patterns provide the consistency and reliability needed to compare the instrument's scores with scores representing defined student outcomes.

The first step was to review research and the "best practices" in school design. A basic assumption for the field of psychology is that young students' interactions with their physical settings may become their primary medium for learning. Physical arrangements of classroom space and class size communicate expectations for behavior reinforced by institutional policy decisions.

Since the developmental process of children can be influenced by characteristics of the physical setting, there are important fundamentals to be considered when designing and planning schools. We believe the 51 items that are distributed among six sections (found in the current version) cover many of the conceptual design aspects of an elementary school. We welcome arguments to include additional items and reasons to delete some that are included in this version.

Guiding propositions found as 'best practices' and those supported by research are outlined within each section of the instruments' components. The attached bibliography provides all the sources used in developing the DASE.

Components of the DASE:
The degrees of functionality, safety, adequacy, quality, and presence are measured with a 10-point Likert Scale, where 10 = 100%, 1 = 10%, and 'not present or very weak' = no response.

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Section I- DEGREE OF FUNCTIONALITY

Functionality refers to how well the design item complements the learning environment.

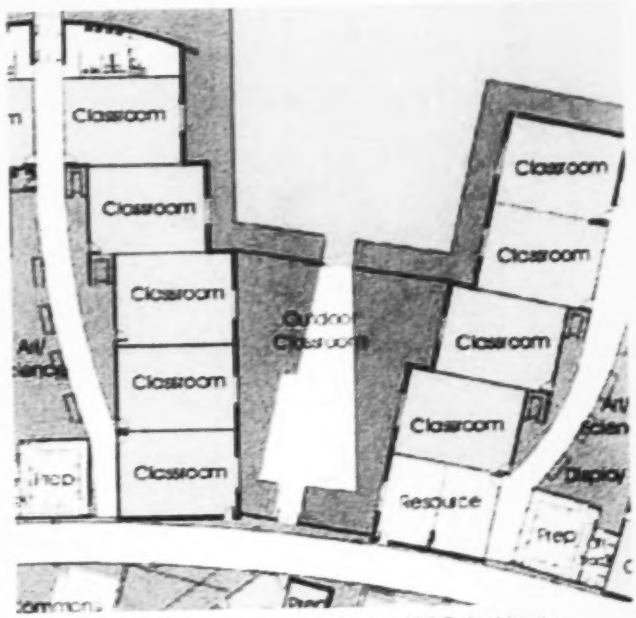
1- Promenade — Walkways linking main outside areas, ideally placing major activity centers at the extremes.

2 - Green Areas - Outside spaces, close to the school building, where trees, grass or gardens may be seen [but no cars or roads].

3 - Quiet Areas —Solitary places where students may go to pause and refresh themselves in a quiet setting.

a. Inside Places
b. Outside Places

4 - Play Areas - Special locations where children are given the opportunity to be together, use their bodies, build muscles, and test new skills. Using imagination and releasing energy are two important activities seen in these areas.



Davis County Elementary, Utah, VCBO Architects

5 - Campus Plan - Several natural and built structures that may be connected by walkways (sometimes covered), pathways, and/or promenades that complement the delivery of the educational program.

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Davidson Elementary, N. Carolina, Adams Group, Architects

6 - **Entrance Area** — A friendly space connecting the outside world to the inside world. This age appropriate space should be inviting and highly visible for students and visitors. It should evoke a 'welcome' feeling.

7 - Private Spaces for Children —Social places where a small group of children may go to be alone (i.e. reading areas, quiet places, reflection areas, listening areas, etc.).

a. Inside
b. Outside

8 - Instructional Neighborhoods — Places [perhaps wing(s) of the building] that include teacher planning spaces, flex zones (places for multiple use), small and large group areas, wet areas for science and art, hearth areas, and restrooms. The hearth area is a place used for reading and quiet time.

a. Teacher planning areas
b. Flex zones
c. Small group areas
d. Large group areas
e. Wet areas for science
f. Wet areas for art
g. Hearth areas

9 - Outdoor Rooms - Defined outdoor learning environments - enough like a classroom, but with the added beauties of nature.

10 - Circulation Patterns - Indoor spaces for circulation should be broad and well-lit allowing for freedom of movement.

a. Within learning environments
b. Among learning environments

11 - Hallways — Passageways, allowing students personal space when moving within the school. [Ample spaces — non-crowded]

12 - Reference - Main building has an obvious point of reference among the school's buildings. It is a focal point where paths and buildings connect. This design feature heightens the sense of community. It stimulates students' imagination.

13 - Building on Student's Scale - A place designed and built to the scale of children (e.g. Door handles or handrails low enough for children to reach to accommodate their heights.)

a. Light switches
b. Seats fit children
c. Door handles
d. Hand rails
e. Shortened steps
f. Water fountains
g. Views (doors/windows that allow the student to easily see the outside)

14 - Administration Centralized - Administrative offices are grouped together in a centralized area allowing for connection and convenience. If there are schools within a school or a campus plan, the person in charge should be readily accessible (at least for the safety of

the children).

15 - Acoustics - Control of internal and external noises levels.

16 -Windows — Spaces bringing natural light into the learning environment. Windows may have some form of glare control, but should be in use (when glare is not a problem), and be without painted obstructions and other devices that restrict views. Windows should invite the outdoors inside.

a. Views overlooking life
b. Unrestricted views (when glare is not a problem)
c. Adequacy of natural light (includes skylights and borrowed light — natural, reflected light)

17 - Intimacy Gradients - A sequence from larger to smaller - public to private spaces, giving the effect of drawing people into the area. These are usually found in main entrances, but may be used through out the learning environment.

18 - Technology for Students - Spaces with computers, compact disks, programs, learning packages, Internet connections, television, and video.

a. Computers are placed within the learning environment in a manner that complements teaching and learning. Computers appear as an integral part of the curriculum.
b. Computer laboratories are not arranged in a rigid, institutionalized, manner.
c. The teacher can easily view all computer screens from one location.

19 -Technology for Teachers — Computers (including laptops), multimedia and Internet connections are easily accessible. Teachers have access to technology (outside the media center) for use in research and planning lessons.

20 - Pathways - Clearly defined areas that allow freedom of movement among structures. These play a vital role in the way people interact with buildings. Pathways may also connect buildings to one another so that a person can walk under the cover of arcades.

21 - Public Areas — Spaces fostering a sense of community (unity and belonging) that offer inviting and comfortable settings, including ample lighting.

a. Auditorium
b. Amphitheater
c. Media center
d. Commons (place for casual student meeting)
e. Dining room

22 - Context - The school and grounds are compatible with the surroundings and sufficient to facilitate the curriculum and programs.

23 - Harmony - The school is "in harmony with nature." It blends with the surroundings and brings nature into the learning environments.

24 - Comfort - Classrooms create a stress-free atmosphere.

25 - Excitement - Classrooms create an atmosphere of excitement for learning.

26 - Learning Zones —

a. Variety of indoor spaces developed to meet individual learning styles.
b. Variety of outdoor areas developed to meet individual learning styles.

27 - Climate Control - A system designed to maintain a comfortable temperature in the classroom learning environment.

28 - Intimacy - Spaces suitable for small children to reflect.

29 - Classrooms - Exterior doors lead to a courtyard or well planned outdoor learning areas.

30 - Communications —

a. Phones within classrooms
b. Two way intercom system
c. Phones in teachers' workrooms
d. Fax machines in teachers' workrooms

31 -Workrooms - Workrooms are near classrooms.
32 - Classroom Walls - Walls are conducive for displaying students' work
33 - Hallways - Hallways are favorable for displaying student work
34 - Roof system — A leaking roof can disrupt student learning.

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Section II - DEGREE OF SAFETY

35 - Safe Location — The site and learning environments are free of excessive non-pedestrian traffic and noise. Natural or built barriers may protect these areas.
36 - Safe Place — The indoor and outdoor environments guarantee students and teachers secure and comfortable places to learn.

a. Separate age-level playgrounds
b. Separation of large and small children
c. Bathrooms in classrooms
d. Supervisable circulation patterns
e. Day security system (alarms, lights, locks)
f. Developmentally appropriate playground equipment
g. Safe playground equipment
h. Evening security system (alarms, lights, locks)

Horizon Elementary, IN, Fanning/Howey, Architects

Section III — DEGREE OF ADEQUACY

37 - Storage — Secured spaces for teachers and students to store their personal belongings, tools and supplies.
38 - Ceiling Heights - A variation of ceiling heights allows individual comfort and intimacy within the school.
39 - Background Detail — Spaces for colorful displays on walls and doors (e.g. light switches, wall outlets, louvers, and surface raceways) that might be unnoticed by adults.
40 - Visual Stimulation - Walls and finishes should effectively display color and vivid patterns.
41 - Personal Artifacts - Places designed for items of a personal nature that relate to each student.

Honeycutt Elementary, NC, Shuller, Ferris Architects

Section IV - DEGREE OF QUALITY

42 - Natural Light/ Full Spectrum - Artificial light plus natural light from the outside, preferably on two sides of every room.
43 - Living Views - Views of indoor and outdoor spaces (gardens, animals, fountains, mountains, people, etc.) These allow minds and eyes to take a break.
44 - Paths with Goals - Places designed to provide focal points when walking to particular locations. (E.g. displays of students, work, meaningful posters, benches, or plants).

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45 - Personal Space - Places for children to participate in activities and tasks without being jammed (crowded).
46 - Activity Pockets - Spaces designed for small group work.
47 - Outdoor Spaces - Places which are defined; may be surrounded by wings of buildings, trees, hedges, fences, fields, arcades or walkways.

Section V — DEGREE THAT THE PATTERN IS PRESENT

48 - Learning Signature - The school's focus and passion. If, after touring the school, you have to ask, the school probably does not have one.
49 - Animal Life - Places in a school or on the school grounds for animals to live (Includes butterfly houses, bird houses, trees, etc…). Caring for animals helps teach the students a sense of responsibility and respect (Values).
50- Community Hub — School and community cooperate [school and community projects and community uses school facilities (media center, gymnasium, lunchroom, etc.) and outdoor learning environments].

SECTION VI - OVERALL IMPRESSION

51 - Overall Impression — Judged based on whether the learning environments are student friendly and teacher friendly.

Additional Areas Under Consideration:

Since the first test, several other items have been suggested by participants. Also, there is new evidence in the literature indicating a need to expand the instrument. Therefore, the items shown below may be included in the next round of validation for the elementary school version.

• *Small schools* (400 -650 students) lead to improved student achievement for 'at risk students.'

• *Small class size* (13 -17 students) in primary grades can raise student achievement and increase equity.

• Aggression and destructive behavior are increased as the number of children in a room increase. Over crowding implies large classes and schools that are 'over capacity.'

• High-density schools have negative influence on achievement. High density equals lower student achievement and increased behavioral problems.

• With the ever increasing need to control violence in our schools, it is essential to consider crowding in the physical environment as an influence on design factors such as circulation patterns, personal space for learning, and freedom of movement.

• Modified open spaces contribute to smaller group sizes and more exploratory behavior.

• It is important to infuse physical settings for children with the sense of being in nature.

• The juxtaposition of several playground elements into a "super unit" supports sustained play more than the same pieces would individually.

- Schools need many windows for natural light.
- Full-spectrum light is critical to a child's health and development.
- Adherence to scale is necessary to produce learner-friendly schools.
- Windows should be low enough for children to "see out."
- Context also includes the school's activity nodes that may be interpreted as "cooperating facilities."
- Independent instructional neighborhoods within each building and campus are recommended.
- Special spaces should address design aspects concerning the ethnic, religious, and cultural background of the students, the economic mix of parents, and the educational profile of the community.
- Indoor pathways may be color coded to assist in keeping students oriented to the front, back, and other important locations within the learning environment.
- Good design ensures access to the sunny side of the structure and makes all outdoors space usable (positive outdoor space - gardens, for example).
- Students need daylight to regulate "circadian rhythms."
- Poorly lit classrooms can cause students to experience a daily form of "jet lag."
- Some forms of florescent lighting may affect some students by causing mild seizures.
- Hierarchy of open space (views into larger or smaller spaces) provides an inviting transition (intimacy gradients to create a sequence from public to private spaces and vice versa).

The instrument and above section are not an exhaustive, therefore, we will continue to work on the validity of the instrument and seek input from responsible sources. The collection of theoretical and research-based patterns should supplement the search for the relationship between school design and student performance.

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Validity and Reliability

Interpretation of scores from the DASE ultimately involves predictions. Perhaps a comprehensive design assessment instrument can estimate a student's behavior, attitude, self-concept in a given school setting1. Assuming the instrument is standardized, conceivably it will become a valid and reliable predictor of student outcomes and average standardized test scores in a specified school2.

If the instrument is an accurate predictor, it is said to have good validity. Before validity can be demonstrated, an instrument must first yield consistent, reliable measurements. In addition to reliability, psychologists recognize three main types of validity:

1. An instrument has content validity if the sample of items in its content is representative of all the relevant items that might have been used. Words included in a spelling test, for example, should cover a wide range of difficulty. Descriptors in the DASE should cover a wide range of design patterns.

2. Criterion-related validity refers to an instrument's accuracy in specifying a future or concurrent outcome. For example, a mathematics-aptitude test has predictive validity if high scores are achieved by those who later do well in mathematics. A school scoring high on the DASE is expected to influence behavior and learning in a positive manner; and the converse is also true. The concurrent validity of the instrument may be demonstrated if its scores correlate closely with well established tests such as the Iowa Test of Basic Skills. If a school has a high score on the DASE, it is assumed that ITBS scores will also be high.

3. Construct validity is generally determined by investigating what qualities an instrument measures; in this case, by demonstrating that certain design patterns account for some degree of a school's quality. If DASE can be shown to predict quality of the total school design, for instance, then it may also predict quality of student outcomes. The validation task is to be accomplished through several trials such as reported here3.

The First Two Tests of Reliability

In the Fall of 1999, a sample of 15 educators trained in school design made an assessment of one elementary school by using the version of the DASE depicted in the 51 items above. Two weeks later, they were asked to repeat the assessment. These data were coded and analyzed for internal consistency to create a reliability coefficient known as Chronbach's Alpha (?). The index created for the instrument in question is based on the average correlation among items within the instrument, where responses are standardized to a standard deviation of 1. The results are shown in Table 1.

In Section I, there are few problems as uncovered by the analysis. Refinement, of item number 18 (technology for students) will improve reliability. Section II, degree of safety also needs some refinement. Additional areas may be added. Given the item analysis, the question of bathrooms in each classroom may need to be stated differently or eliminated. While having bathrooms in every classroom is ideal, the financial feasibility may be questioned (personally I prefer this because of safety and security factors). Section III revealed no major difficulties.

The degree of quality, Section IV, disclosed the least variation between the two trials. No items need to be eliminated in the fourth section. A review of the coefficients for Section V indicates that some change is needed, particularly the addition of some more global patterns. The statements concerning "animal life" need refinement.

Table 1. Tests of the scale's reliability

Section	Test 1 - Standardized ?	Test 2 - Standardized ?
I	.88	.93
II	.70	.82
III	.86	.89
IV	.87	.89
V	.76	.86
VI	.76*	.91*

* Alpha for all 51 items. If Item 51 were deleted, the correlation would be .75 and .91, respectively, indicating that it is an important item.

Correlation between items 51 and the total score were .72 and .71 respectively. Item 51, while being important may need refinement.

Conclusions

Sections II, V, and VI need revision. They reveal concerns for clarification, perhaps more content validity. On the other hand, Sections I, III, and IV could stand as they are. During the next phases of development, all sections will probably take on some changes of content and clarity. While the standardized alpha for the entire scale, as shown for Test-2, was .91, the internal parts (II, V, and VI) are in need of improvement. Furthermore, given the nature of reliability estimation models, larger numbers of items have a tendency to yield larger coefficients.

Let us go back to the original questions: Does the DASE include the most significant and valid aspects of design for elementary schools? [Answer: Not completely, some sections need refinement]. Will it consistently measure these important design patterns? [Answer: Yes, when validity is improved].

Notes:

1. Remember it was Skinner who said that environment is a behavior modifier and Lewin who taught that behavior is a function of the field that exists at the time the behavior occurs.

2. It is not for me to say that this cannot be done. To me, it is within the realm of possibility to predict the average set of scores from a well-defined population with a 'finely tuned' instrument. The argument against this is that there are too many uncontrolled social and economic variables in public schools. However, we are talking about averages of scores for a complete school setting, not individual scores - averages of averages in some cases. Relate this problem to what marketers do all the time. If a sample of 1000 people are driving new Jaguar cars, then the estimated average personal income of the driver is greater than or equal to $100,000.00 per year (We may also assume that these people are college graduates who

made above average scores on the ACT or SAT). Analogies may be made for drivers of sub-compact cars, for drivers of pick up trucks, types of desks sold to certain schools, and for owners of about any item sold. So, if predictions can be made about all these commercial objects, why cannot we make them about what people (groups representing certain social classes) buy in the name of educational facilities. Given a certain area of the world, can't we predict the type of schoolhouse that a certain society will buy for their children? Then, by inference from school design, measures of behavior, attitude, and self-concept can't we make a probability statement how these students will fare on standardized tests - cognitive learning (on the average)?

3. The amount of time and resources to construct an assessment scale are enormous. The SDPL, a nonprofit unit of the University of Georgia welcomes supports for research and development. SDPL's web site may be found at [http://www.coe.uga.edu/sdpl/sdpl.html].

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